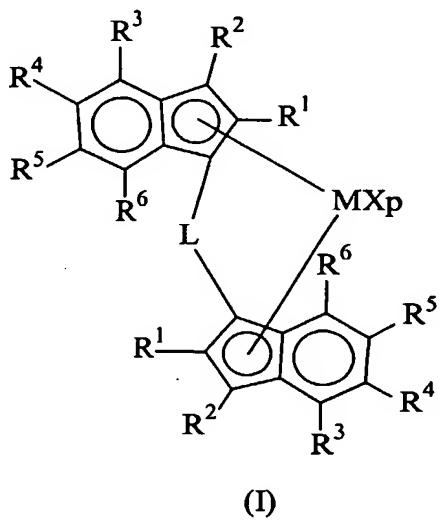


CLAIMS

1. A process for preparing 1-butene polymers optionally containing up to 30% by mol of derived units of ethylene, propylene or an alpha olefin of formula $\text{CH}_2=\text{CHZ}$, wherein Z is a $\text{C}_3\text{-C}_{10}$ alkyl group, comprising polymerizing 1-butene and optionally ethylene, propylene or said alpha olefin, in the presence of a catalyst system obtainable by contacting:
- a) at least a metallocene compound of formula (I):



wherein:

M is an atom of a transition metal selected from those belonging to group 3, 4, 5, 6 or to the lanthanide or actinide groups in the Periodic Table of the Elements;
 p is an integer from 0 to 3, being equal to the formal oxidation state of the metal M minus 2;

X, equal to or different from each other, are hydrogen atoms, halogen atoms, or R, OR, OSO_2CF_3 , OCOR, SR, NR_2 or PR_2 groups, wherein R is a linear or branched, saturated or unsaturated $\text{C}_1\text{-C}_{20}$ alkyl, $\text{C}_3\text{-C}_{20}$ cycloalkyl, $\text{C}_6\text{-C}_{20}$ aryl, $\text{C}_7\text{-C}_{20}$ alkylaryl or $\text{C}_7\text{-C}_{20}$ arylalkyl radical, optionally containing heteroatoms belonging to groups 13-17 of the Periodic Table of the Elements; or two X can optionally form a substituted or unsubstituted butadienyl radical or a OR'O group wherein R' is a divalent radical selected from $\text{C}_1\text{-C}_{20}$ alkylidene, $\text{C}_6\text{-C}_{40}$ arylidene, $\text{C}_7\text{-C}_{40}$ alkylarylidene and $\text{C}_7\text{-C}_{40}$ arylalkylidene radicals;

R' , equal to or different from each other, are linear or branched, saturated or unsaturated $\text{C}_1\text{-C}_{20}$ -alkyl, $\text{C}_3\text{-C}_{20}$ -cycloalkyl, $\text{C}_6\text{-C}_{20}$ -aryl, $\text{C}_7\text{-C}_{20}$ -alkylaryl or

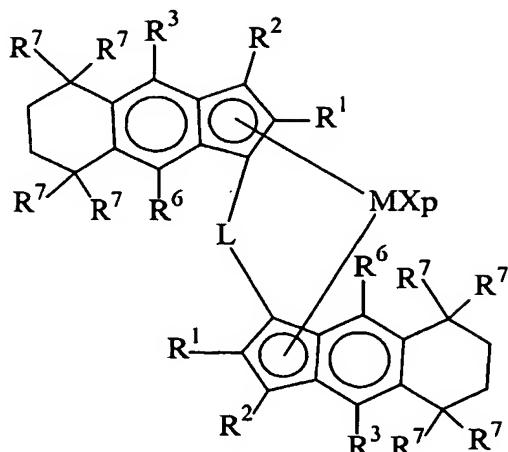
C_7 - C_{20} -arylalkyl radicals, optionally containing one or more heteroatoms belonging to groups 13-17 of the Periodic Table of the Elements;

R^2 , R^3 and R^6 , equal to or different from each other, are hydrogen atoms or linear or branched, saturated or unsaturated C_1 - C_{20} -alkyl, C_3 - C_{20} -cycloalkyl, C_6 - C_{20} -aryl, C_7 - C_{20} -alkylaryl or C_7 - C_{20} -arylalkyl radicals, optionally containing one or more heteroatoms belonging to groups 13-17 of the Periodic Table of the Elements;

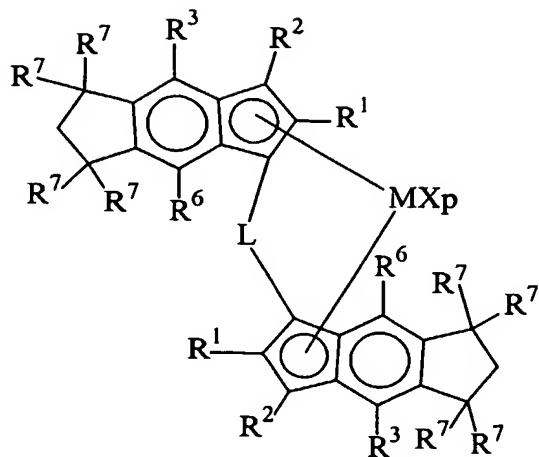
R^4 and R^5 , form together a condensed saturated or unsaturated C_3 - C_7 membered ring optionally containing heteroatoms belonging to groups 13-16 of the Periodic Table of the Elements; every atom forming said ring being substituted with R^7 radicals wherein R^7 , equal to or different from each other, are hydrogen atoms or linear or branched, saturated or unsaturated C_1 - C_{20} -alkyl, C_3 - C_{20} -cycloalkyl, C_6 - C_{20} -aryl, C_7 - C_{20} -alkylaryl or C_7 - C_{20} -arylalkyl radicals, optionally containing one or more heteroatoms belonging to groups 13-17 of the Periodic Table of the Elements;

L is a divalent bridging group selected from C_1 - C_{20} alkylidene, C_3 - C_{20} cycloalkylidene, C_6 - C_{20} arylidene, C_7 - C_{20} alkylarylidene, or a C_7 - C_{20} arylalkylidene radical optionally containing heteroatoms belonging to groups 13-17 of the Periodic Table of the Elements, or a silylidene radical containing up to 5 silicon atoms; and

- b) an alumoxane or a compound able to form an alkylmetallocene cation.
- 2. The process according to claim 1 wherein the catalyst system further comprises an organo aluminum compound.
- 3. The process according to claim 1 or 2, wherein in the compound of formula (I) M is titanium, zirconium or hafnium; X is a hydrogen atom, a halogen atom or a R group wherein R has the same meaning as in claim 1 and L is $Si(R^8)_2$, wherein R^8 is a linear or branched, saturated or unsaturated C_1 - C_{20} -alkyl, C_3 - C_{20} -cycloalkyl, C_6 - C_{20} -aryl, C_7 - C_{20} -alkylaryl or C_7 - C_{20} -arylalkyl radical.
- 4. The process according to anyone of claims 1 to 3 wherein R^1 is a C_1 - C_{20} -alkyl radical; R^2 , R^3 and R^6 are hydrogen atoms and R^7 is a hydrogen atom or a linear or branched, saturated or unsaturated C_1 - C_{20} -alkyl radical.
- 5. The process according to anyone of claims 1 to 4 wherein the compound of formula (I) has formula (IIa) or (IIb):



(IIa)

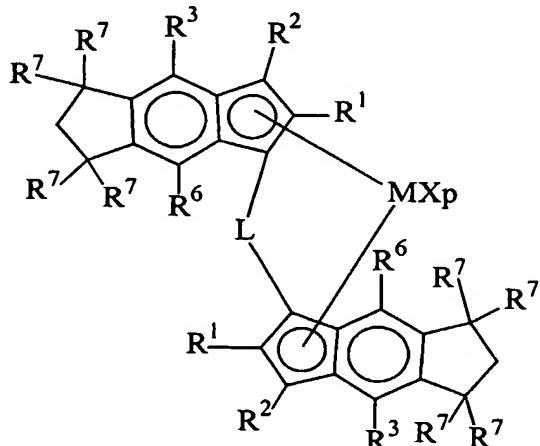


(IIb)

wherein:

M, X, p, L, R¹, R², R³, R⁶ and R⁷ have the same meaning as in claim 1.

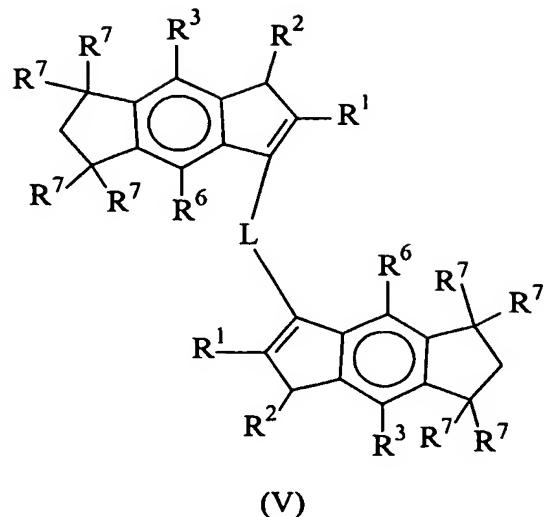
6. The process according to anyone of claims 1 to 5 wherein 1-butene is homopolymerized.
7. A metallocene compound of formula (IIb):



(IIb)

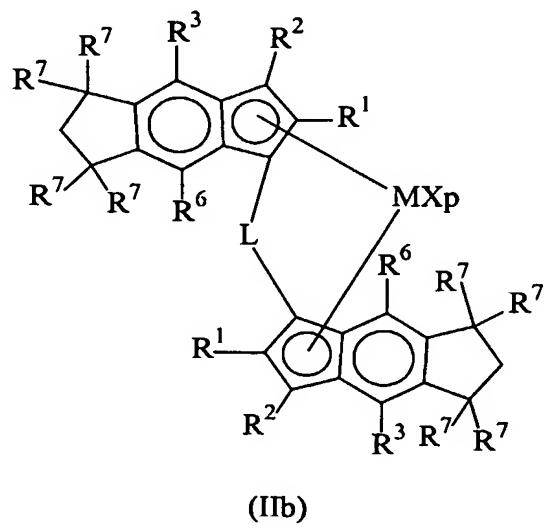
wherein M, p, L, R¹, R², R³, R⁶, R⁷ and X have the same meaning as in claim 1.

8. A ligand of formula (V) or its corresponding double bond isomer:



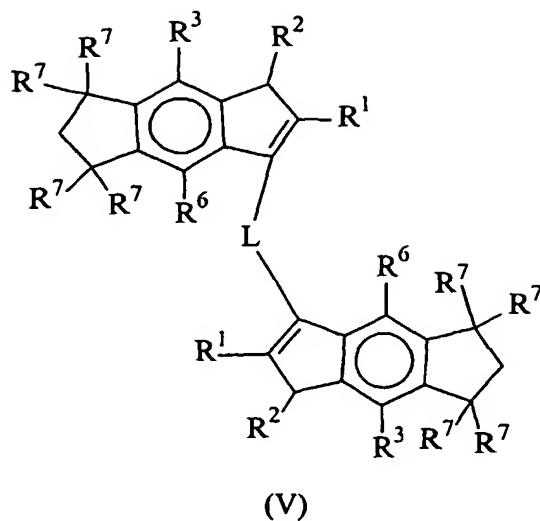
wherein L, R¹, R², R³, R⁶, and R⁷ have the same meaning as in claim 1.

9. A process for preparing the metallocene compound of formula (IIb):



wherein M, p, L, R¹, R², R³, R⁶, R⁷ and X have the same meaning as in claim 1 comprising the following steps:

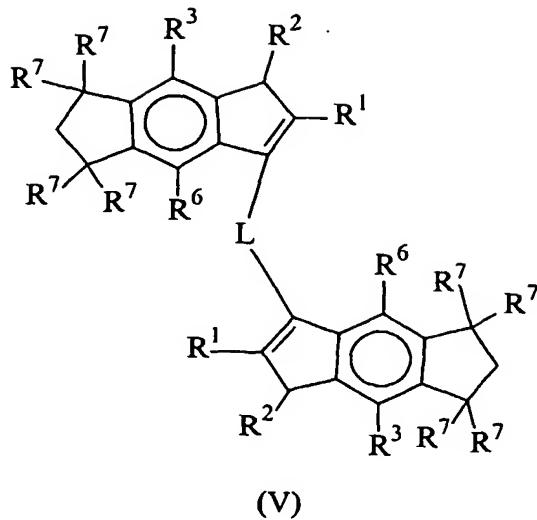
- a) contacting a ligand of formula (V)



or its double bond isomer

wherein R^1 , R^2 , R^3 , R^6 , R^7 and L have the same meaning as in claim 1 with a base of formula T_jB or $TMgT^1$, or sodium or potassium hydride, or metallic sodium or potassium; wherein B is an alkaline or alkali-earth metal and j is 1 or 2, j being equal to 1 when B is an alkaline metal, and j being equal to 2 when B is an alkali-earth metal; T is selected from the group consisting of linear or branched, saturated or unsaturated C_1-C_{20} alkyl, C_3-C_{20} cycloalkyl, C_6-C_{20} aryl, C_7-C_{20} alkylaryl or C_7-C_{20} arylalkyl groups, optionally containing one or more Si or Ge atoms; T^1 is a halogen atom or a group OR'' wherein R'' is a linear or branched, saturated or unsaturated C_1-C_{20} -alkyl, C_3-C_{20} -cycloalkyl, C_6-C_{20} -aryl, C_7-C_{20} -alkylaryl or C_7-C_{20} -arylalkyl radicals, optionally containing one or more heteroatoms belonging to groups 13-17 of the Periodic Table of the Elements; wherein the molar ratio between said base and the ligand of the formula (V) and is at least 2:1; and

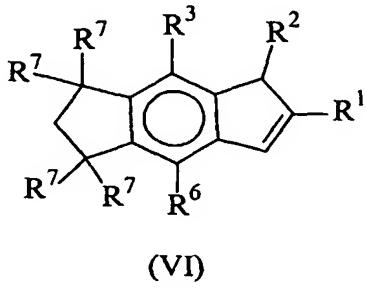
- b) contacting the product obtained in step a) with a compound of formula MX_4 wherein M and X have the same meaning as in claim 1.
10. A process for preparing the ligand of formula (V)



or its double bond isomer

wherein R^1 , R^2 , R^3 , R^6 , R^7 and L have the same meaning as in claim 1, comprising the following steps:

- a) contacting a compound of formula (VI):



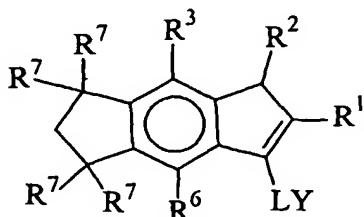
or its double bonds isomer

wherein: R^1 , R^2 , R^3 , R^6 , and R^7 have the same meaning as in claim 1;

with a base of formula T_jB or $TMgT^1$, or sodium or potassium hydride, or metallic sodium or potassium; wherein B is an alkaline or alkali-earth metal and j is 1 or 2, j being equal to 1 when B is an alkaline metal, and j being equal to 2 when B is an alkali-earth metal; T is selected from the group consisting of linear or branched, saturated or unsaturated C_1-C_{20} alkyl, C_3-C_{20} cycloalkyl, C_6-C_{20} aryl, C_7-C_{20} alkylaryl or C_7-C_{20} arylalkyl groups, optionally containing one or more Si or Ge atoms; T^1 is a halogen atom or a group OR'' wherein R'' is a linear or branched, saturated or unsaturated C_1-C_{20} -alkyl, C_3-C_{20} -cycloalkyl, C_6-C_{20} -aryl, C_7-C_{20} -alkylaryl or C_7-C_{20} -arylalkyl radicals, optionally containing one or more heteroatoms belonging to groups 13-17 of the

Periodic Table of the Elements; wherein the molar ratio of said base and the compound of the formula (VI) is at least 1:1;

- b) contacting the obtained anionic compounds obtained in step a) with a compound of formula (VII):



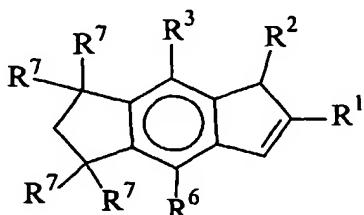
(VII)

or its double bonds isomer

wherein R¹, R², R³, R⁶, R⁷ and L have the same the same meaning as in claim 1 and Y is a halogen radical selected from the group consisting of chloride, bromide and iodide.

11. A process for preparing the ligand of formula (V) when the substituents R¹, R², R³, R⁶ and R⁷ are the same in both the indenyl moieties comprising the following steps:

- a) contacting a compound of formula (VI):



(VI)

or its double bonds isomer

wherein: R¹, R², R³, R⁶ and R⁷ have the same the same meaning as in claim 1; with a base of formula T_jB or TMgT¹, or sodium or potassium hydride, or metallic sodium or potassium; wherein B is an alkaline or alkali-earth metal and j is 1 or 2, j being equal to 1 when B is an alkaline metal, and j being equal to 2 when B is an alkali-earth metal; T is selected from the group consisting of linear or branched, saturated or unsaturated C₁-C₂₀ alkyl, C₃-C₂₀ cycloalkyl, C₆-C₂₀ aryl, C₇-C₂₀ alkylaryl or C₇-C₂₀ arylalkyl groups, optionally containing one or more Si or Ge atoms; T¹ is a halogen atom or a group OR" wherein R" is a linear or branched, saturated or unsaturated C₁-C₂₀-alkyl, C₃-C₂₀-cycloalkyl,

C_6 - C_{20} -aryl, C_7 - C_{20} -alkylaryl or C_7 - C_{20} -arylalkyl radicals, optionally containing one or more heteroatoms belonging to groups 13-17 of the Periodic Table of the Elements; wherein the molar ratio between said base and the compound of the formula (VI) is at least 1:1;

- b) reacting the product obtained in step a) with a compound of formula YLY, wherein L and Y have the same the same meaning as in claim 9 wherein the molar ratio between the compound obtained in step a) and the compound of formula YLY is at least 2:1